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*Some Account of James Dodson, F.R.S.* By A. DE MORGAN, Esq.

NO life has been written of the original projector of the Equitable Society, except in a column of the *Biographie Universelle* by M. Nicollet. Dodson's name was, and even still is, so familiar to the actuary, chiefly through the *Mathematical Repository*, and the impulse he gave to life-contingency problems, that this *Journal* is the proper place of deposit for what can be collected concerning him. The article above mentioned tells very little. He succeeded Hodgson [which should have been Robertson] in the chair of mathematics at *Christchurch Hospital* in 1756 [1755] and died November 23, 1757. He published the *Antilogarithmic Canon*, which others had contemplated [and executed too, but the manuscript was lost] and which he had the courage to execute up to a certain point [his table is the counterpart of Vlacq's largest direct table: five figures of argument and eleven of tabular result]. He could not *balance* the success of the ordinary tables: the writer doubts whether the table was ever used on the continent [he might have added, England: who *uses* either Vlacq or Dodson? Their tables are for help to other table-makers, and always were, though both of them intended more]. He published the *Calculator* in 1747, a collection of tables at the end of which [say in the proper

place in the middle] is an abridgment of the antilogarithmic table. But he is best known in England by his *Mathematical Repository*, and by his zeal for benevolent institutions [say his determination to found an assurance office to which himself should be admissible]. In his lectures at the school of Christ-church Hospital he gave the first idea of a company for life assurance, a plan afterwards executed by Edw. Rowe Mores [and others] under the name of the *Equitable Society* [I may safely contradict the statement that he lectured on life-assurance to the young men whom he was to instruct in mathematics and navigation].

James Dodson was my mother's father's father. All knowledge of him was completely cut off from his posterity by his leaving no near relation, no widow, and no child above fourteen years of age. I have, in several cases, found biographical inquiry arrested by similar circumstances. He seems to have had but two children, both sons. One, the elder, reared a large family, and must have, by this time, upwards of a hundred and fifty descendants, dead and alive : but never more than one male descendant of the name in my generation. So much for the efficacy of a large preponderance of daughters in preserving a surname. Of the other, nothing was ever remembered except that he "gave his brother much trouble." With all my inquiry, curious as I was to know all about this ancestor, I never obtained from his family more than three pieces of information : the date of his eldest son's birth ; a copy of his treatise on book-keeping, which seems to have been preserved by his son, and which was given to me by one of his grandsons ; a tradition that he was befriended on some occasion by the Duke of Manchester, who I have no doubt was a misnomer of the Earl of Macclesfield.

This paper is a case of the problem of constructing an unknown biography out of materials equally common to all mankind : and a sketch of a career may be given, as complete as many which are taken from contemporary record, and of much better evidence as to the separate facts than the unsupported statement of a casual writer. What may be done by one who takes the interest of a descendant in the matter is equally possible to be done by others : and a person who systematically collects all the biographical facts he meets with may find himself in a condition to give no small number of accounts, sufficient for literary purposes, of persons whose lives have been neglected.

James Dodson must have been born shortly before 1710 : who he was, or from whence, I never found the slightest information.

From their long and close intimacy it must be suspected that he was a contemporary, perhaps a schoolfellow, of John Robertson (born 1712) the author of the *Navigation*, who in the history of Christ's Hospital is called the brother of Robertson the historian. But the following is more direct. In 1756, he found he could not assure in the Amicable Society, being over age : their limit was 45 ; and all accounts imply that he had but just passed the limit. He must have had some sort of liberal education ; for his use of the Bernoullis, Euler, Ozanam, &c., shows that he read Latin and French. He must have been thrown on the world with some little command of money. He was able to spend unprofitable years in the construction of his antilogarithmic table, which he published on his own account in 1742 : it was his first public appearance. A publisher's name (Wilcox) is joined with his own in the imprint : but we may be pretty sure that a folio of new tables at £1. 2s. 6d. (afterwards reduced to 12s.) by a young man quite unknown, would not find a publisher to take any risk. Those whom he mentions as his friends are Robertson, William Jones, of whom presently, and Labelye, who was, I believe, then building Westminster Bridge. Again, he had been, as we shall see, a pupil of De Moivre, who was at the top of the tree, and who must have been, at the time of Dodson's pupillage, very well remunerated, as one of the most famous of mathematicians, and Newton's particular friend. Between the *Canon* and the next work on his own account, he added a wife to his means of expenditure, which looks as if the money were not quite gone. He must have married soon after the publication of the *Canon*, for his first son was born in 1743. He was, I suppose, an amateur worker up to this time : for he is not called 'teacher of the mathematics' in the title of the *Canon*, though, had he been thus employed, the advertisement would have been a very good one : it first appears in 1747.

I have said he was a pupil of De Moivre. This is attested by Matthew Maty (M.D., afterwards Sec. R. S.) in his life, which is very little known, of his most particular friend De Moivre. Maty gives, as specimens of the pupils, Macclesfield, Cavendish, Stanhope, Martin Folkes, Fatio de Duillier, Scot, Daval, and Dodson. Of Lord Macclesfield I need say nothing ; nor of Stanhope (the well known Lord Chesterfield), Folkes and Duillier. Cavendish was probably Lord Charles Cavendish, the father of the great chemist. Scot[t] was probably one of two fellows of the Royal Society of that name. Daval was a noted lawyer of a scientific turn, no doubt the Peter Daval who became Secretary

of the Royal Society in 1759. Those who look into the history of the time will find evidence of a *De Moivre clique*, kept together by intercourse with their old teacher, who lived until 1754, and by Maty's interest in the pupils of his old friend. Maty edited the *Journal Britannique*, a London publication in French, which expired shortly after De Moivre's death, living long enough to contain the biography mentioned, which was soon published separately. When any one of the pupils published a work, it was immediately favourably reviewed. When Sam Johnson's dictionary appeared, the review suppressed all about the celebrated letter to Lord Chesterfield, and hinted that Johnson should not have cast off the patron he himself had chosen at the beginning. So Johnson said of Maty, "He! the little black dog! I would throw him into the Thames:" from this we draw an inference which, in some very grave and dignified dictionary, will one day appear as "We have the testimony of the celebrated Dr. Johnson that Maty was short and dark: some take the great lexicographer as saying that he was of a surly temper, and not so much given to ablution as would in our time be held desirable; but we doubt if we can safely adopt this interpretation."

Various relations between the pupils are found. Lords Macclesfield and Chesterfield moved and seconded the second reading of the change of style; and Daval drew the bill. Dodson dedicated to his old teacher, and to the two peers; by whom he was also employed in surveying and accounts. I trace him through his writings as a private teacher, accountant, surveyor, &c., probably an answerer of actuary's cases, until 1755, when he gained what was for him a splendid rise in the world.

Charles II., who was a dabbler in science, and sometimes in a more creditable way than assisting at the joke of dissecting the body of an infant picked up about the palace,—and who really had that sense of the importance of navigation which an English Sovereign ought to have,—founded three *Royal* Institutions: the Royal Society, the Royal Observatory, and (1673) the Royal Mathematical School, attached to Christ's Hospital, for mathematics and navigation. The "New System of Mathematics" (2 vols. 4to. 1681) was written for this school by Jonas Moore, Master of the Ordnance, by whose advice it was founded: the course was left not quite finished, and Halley and Flamsteed took part in its completion. This school has always been distinct from the ordinary teaching of the Hospital, being especially devoted to navigation: and I have seen an elementary work announced as

intended for both the schools. At first the teachership was an office of very high consideration. When the Royal Society nominated Halley on the committee for keeping Newton to his work (the *Principia*) or as they phrased it, to "keep Mr. Newton in mind of his promise," the second member, who had a mere sinecure, would certainly be a person whose position was a guarantee for most respectful meaning on the part of the Society; especially considering the curious nature of the duty. Except in this instance I never heard of a scientific body extorting a promise that a book should be written, and appointing a committee to see that it was done. This second member was Mr. Paget, or Pagett, master of the Royal Mathematical School: and that he was selected for his position rather than his merits I infer from his carelessness as a teacher being notorious; he afterwards took to drinking, or perhaps we should say that his having taken to drinking afterwards became as notorious as his neglect of his duties. The post gradually declined in external notoriety, as the Royal School—which still exists—was more and more nearly absorbed into the Hospital. Very few of those who hear of the boys annually presenting their charts, &c., for the inspection of the Sovereign are aware that this privilege belongs to the Royal Mathematical School, and not to the Blue Coat School itself. It may be gathered from various circumstances that the post was, in 1755, no mean addition of station to the private teacher who had lived by all kind of odd jobs at "the Blue Legg, near to Bell Dock, Wapping." He gained it, as I suppose, by the influence of Lord Macclesfield, who was then President of the Royal Society: I thus interpret the imperfectly remembered tradition of a granddaughter, that he was befriended by the Duke of Manchester. He was admitted of the Royal Society Jan. 23, 1755, which was probably before his appointment to the teachership in the same year. This is fully confirmed by the third volume of the *Repository*. The preface is dated Jan. 23, 1755, which means that he had waited to date his preface until he could put F.R.S. after his name: a precedent for the Society, should it ever want one, that the *admission*, not the *election* (which had taken place a week before) gives the *literary* character. But he is not styled as of the R.M.S.: only "accountant and teacher of the mathematics." The little point is to the following purpose. The Royal Society was somewhat exclusive during the last century, and rather averse to admit men in trade. But we must infer that Dodson was not elected because his new post made him grand enough, but that he might become

grand enough for the (probably) promised post. His friend Robertson, who preceded him, and whose position exactly resembled his own, had been F.R.S. since 1741: he held the post only about a year. And Hodgson, who came before Robertson, had been in the Society since 1703, five years before he gained the mastership. Accordingly, it seems to have been the rule to fill up the place from among the fellows of the Royal Society: but several of Dodson's early predecessors came into the school first, and into the Society shortly afterwards.

Dodson, thus comparatively enriched and established, wanted to insure his life, and found that the Amicable received no lives over 45. He accordingly set himself (1756) to found a new office; and thus became the projector of the Equitable Society, as presently described. Thomas Simpson was lecturing on the subject, with a view to a new office: Dodson called a meeting by advertisement, and formed a Committee. I find no trace of concert. I suspect that Simpson was looked on coldly by the De Moivre clique: many know the savage onslaught made by De Moivre on Simpson, though it seems the assailant afterwards cooled down. But it may be suspected that respect for the old man who represented the school of Newton, Leibnitz, the Bernoullis, &c., so long after they were gone, prevented much mention of Simpson, whom I do not find prominently cited by Dodson until after De Moivre's death, when he is spoken of in proper terms. A manuscript lecture of the period was lent to me many years ago, which showed no sign of being either by Simpson or by Dodson. Perhaps the plan was stirred in several quarters.

Dodson must have found his position very troublesome. His pupils were about twenty years of age: and the mixture of these men with the boys of the school led to all kinds of disturbance, beginning probably with interchange of chaffing and cuffing. But he did not enjoy it long; he died November 23, 1757. He leaves the character of a useful mathematician, inventive in application, but not in augmentation, of his science. He was eminently effective, and this until long after his death,—indeed, until 1820 at least—in attracting the attention of students of annuities and assurance to the problems connected with their subject. His term of public life was only fifteen years: and he was of a period in which the study of pure mathematics in England was at the lowest ebb. Had a man of thirty-two years old emerged from obscurity in the early time of Newton with such a folio as the *Canon*, no doubt the work of years, he would have been noticed and

encouraged: but nothing of this sort took place. To get an idea of our state at the time, say 1740–1760, take the names of all who were alive in Britain, no matter at what age, in any part of that period, and who can in any way be identified with pure mathematics. We have the remains of the old school, Berkeley, De Moivre, Halley, Jurin, Maclaurin, Robins, Stirling, William Jones and Braickenridge; a powerful list. To them we may add Thomas Simpson, Matthew Stewart, Walmesley, Waring, Robert Simson, Atwood, Hutton, Emerson, Horsley, Maseres, Playfair, Judge Wilson. Dodson, then, is one of the larger stars of his constellation: but the constellation not one of first-rate brilliancy. Reuben Burrow would have been added to my list, if he had published anything of sufficient note: but he appears in another way. Again, look forward to 1807; when we should see the crop of the seed-time just examined. In Mr. Walker's group—published six years ago—of fifty-one men of science of that day, the only two who are at all associated with pure mathematics are Leslie and Playfair.

An inquiry into the state of mathematical studies at Cambridge would probably confirm what I have said. Before such men as Waring, Paley, Milner, Vince, &c., gave strength to the system, I suspect that it was much debilitated. Taking the general results of *senior* wranglership as one test, there is little to speak of until the effect of those I have named began to be seen: and then we have such phenomena as three years which produced two bishops and a lawyer of celebrity, followed by five years which produced four judges. Of the dead period I have but one anecdote which I know to be true: it will look much like caricature. The senior wrangler of 176— was in 1825 still resident in his college, and of course very old. He recommended a young candidate for honours, in presence of one from whom I heard it, to be sure to attend particularly to quadratic equations: it was a quadratic, said he, which made me senior wrangler.

Any degree of celebrity, small or great, is not fairly established until detraction is proved: but this confirmation, as to Dodson, only turned up in our own day. The private diary of Reuben Burrow, a good mathematician, but eminently scurrilous and slanderous, is the place of deposit. For ample proof of this character, see the *English Cyclopædia* 'Tables,' and also *Notes and Queries*, Series I. vol. xii. p. 142 and Series III. vol. v. pp. 107, 215, 261, 303, 361. Burrow did not come into rivalry with Dodson, who is therefore let off cheaply: but poor Wales, against



whom Burrow was an unsuccessful competitor on more occasions than one, particularly for Dodson's old place in 1775, is, with another, "two of the most stupid and most dirty of all possible fools, rogues, and scoundrels," while Wales, he by himself he, is "not only the dirtiest scoundrel that God ever made, but the dirtiest rascal that he possibly could make. Amen." This is in the fly leaf of a book in my possession: my reader will not need me to tell him that Wales was an irreproachable man. From the diary it appears that this character is not entirely given on scientific grounds: for the wife of the said Wales is charged with having been the person who circulated the story that the said Burrow had given his own wife black eyes, a likely thing *per se*. The diary states that Wm. Jones, the father of the Indian Judge, so celebrated for his library and for his allowance of its use—the liberty of his study, Dodson calls it—as well as for his wide acquaintance with the mathematicians, was exceedingly rough and uncourteous: "Gardiner, the logarithm fellow, and Dodson, he used to treat like a couple of dogs." This is against all evidence of Jones's character: and I mention it first to note that Burrow calls Jones the Secretary of the Royal Society, which he never was; and gives Robertson—who was then clerk of the Society—as his informant; who must have known better, and who may safely be set down as never having said so. Probably Burrow confounded his man with Jezreel Jones, who was clerk of the Society, 1698–1713. William Jones was a Welchman, brought up in Wales: and a certain irascibility is held to belong to the national character. In that day, it must be remembered, the temperament of the races was much more pronounced than in our day, in which it would be easy to pick out and bring together an Englishman, a Welchman, a Scotchman, and an Irishman, of whom a fifth person, after hearing them talk for an hour, would be puzzled to say which was which. It may be held credible that Jones occasionally flew out: and his genial disposition, which led him to lay his treasures open to all, especially to the young aspirants whom he was so ready to advise and assist, probably had two warm sides, one at each end. But he had passed a life among his superiors both in station and in science, and all the probabilities of the case, as well as general evidence, are against his having had any reputation for habitual roughness. No name of the period has come down to us in a clearer atmosphere of respect and esteem. Burrow then gives the following account (Aug. 22, 1775).

"I had a good deal of talk with Mr. Robertson, and staid supper. He told me that Mr. Wm. Jones wrote that history of logarithms prefixed to Dodson's tables of the Anti-logarithmic Canon : that Dodson wrote such a confused and odd style that there was neither head nor tail in it, hardly ; and that he himself drew up the examples. He also gave me the history of the Mathematical Repository, as follows. Mr. Robertson having taught General Conway mathematics (who was then only a colonel), after he was member of parliament he called on Mr. R. and told him that as his place in the House hindered his further attendance to mathematical subjects he should drop it, but at the same time he should be glad to have those papers which he had learnt copied over. Mr. R. not having time or inclination to do this himself applied to Dodson. Dodson employed one Ralph to copy them, but at the same time Dodson took a copy for himself (which by the bye was a dirty action). This Mr. R. did not know to a long time after, when, happening to think on the scheme of publishing a mathematical repository, the first volume of which was to contain a volume of algebraical questions, and the second geometrical, he proposed it to Dodson, who readily accepted the offer of joining with him. This Mr. Robertson mentioned to Mr. Jones, but Mr. Jones told him he was against the affair on account of Mr. R.'s probability of publishing some of the methods Jones had taught him, which he (Jones) might have thought of publishing afterwards himself. Mr. R. on this set the affair aside himself, but Dodson went on with it, and the greatest part of the questions in the first volume, at least 200 of the questions, were copied from Mr. Robertson's papers.

It will be worth while to follow up Mr. Burrow, because diary stories have been much relied on, and it will be instructive to point out what their value may be. I will therefore take one of a different kind, also derived from Robertson, upon which, as it happens, we are probably able to confront Burrow with Robertson himself. N.B. The blanks are not Burrow's.

He [Lord Macclesfield] married a —, his family were in confusion, and when he died the — ordered all his papers to be burnt but such as related to money matters, and Jones (*sic*) papers never was (*sic*) seen nor heard of more. Some think they were burnt among the rest, but Horsfall, of the Temple, who was one of those employed, says there were no such papers among those that were burnt. Others say that a number of papers were sent down to Shirborne Castle in his lifetime . . . .

The two octavo volumes of Macclesfield Correspondence—which are but a small portion of the manuscripts now at Shirburn Castle—refute the tale of the burning. And now as to the character of the second Lady Macclesfield. Lord M. is described as having married, in 1757, 'Dorothy, daughter of — Nesbitt.' This short description probably indicates that her family was not of rank or note : but I can find nothing against her in the scandal of the time. Burrow must have mixed her up with *another* story,

which he probably *did* hear from Robertson, who left a slight written account of William Jones among his papers, which Hutton published. Robertson seems to have been one of those retailers of half-told stories who leave their hearers to fill up in their own way. Jones was the director of Lord Macclesfield's education until the young man travelled in France and Italy: and Robertson says "They tell a story of an Italian wedding, which caused great disturbance in Lord Macclesfield's family, but was compromised by Mr. Jones; which gave rise to a saying that Macclesfield was the making of Jones and Jones the making of Macclesfield." The compromise of a wedding was a thing which might have happened in those days, when the marriage-law\* of England was the old law of Europe, which we now call the Scotch law. If the story have any foundation the young lord must have made some exchange of declarations in Italy, with a woman who followed him to England, and Jones may have been employed in buying her off. This seems somewhat supported by the haste with which a wife was found for the young man, who set out on his travels about 1720, and was married to his first wife in 1722. Probably Burrow has spoilt the point of the epigram by reversing the points: if Jones extricated the son, and the father afterwards gave him a good place, it would have been that Jones was the making of Macclesfield, and (then) Macclesfield was the making of Jones. But probably the reference is to some place given by the son, in addition to those already given by the father: Jones was certainly "made" long before 1720.

I now go on to what directly concerns Dodson, who says he got his questions out of mathematicians of the two centuries preceding, of whom he names twenty-one. Burrow says that more than 200 were exercises given by Robertson to General Conway, whom no one will believe to have mastered any 200 that can be pointed out. It is not credible that Dodson, himself a teacher, and a large importer of new algebra into a new subject, should have found it necessary to crib the simple equations, &c., of another teacher. Nor do I believe that Robertson told any such story of his friend past, present and future; especially to such a person as he knew Burrow to be. No doubt he told Burrow something: and Burrow had a power of inference not

\* There was in England an inveterate popular belief, without any foundation in law, that the declarations which made a marriage must be made before a person in orders, English or Roman. There is a great deal of confusion on this subject, in great part arising from not remembering that the marriage by declaration before witnesses, which was *binding* both civilly and ecclesiastically, was held *irregular* by the Church, and made the parties subject to spiritual censures and penances; and also to some statutory penalties, which were seldom or never enforced.

given to all. It was one of those eccentricities of genius in private life—to use the phrase of a biographer—by which he was as much distinguished as by his *nihil quod tetigit non d—navit*. Lord Howe did not convoy the India fleet until they were out of (Burrow's) fear of the French: so it is laid down that "he and his brother are a couple of cowardly scoundrels, or else that they are bribed by the enemy." This was followed by what was perhaps the nearest approach Burrow's mind could make to *Domine, salvam fac patriam*, but worded thus—"What d——d stupidity this cursed nation of ours has fallen into!" Truly he is a person who tempts to digression.

Dodson, in the preface of the Canon, acknowledges much assistance in the drawing up of the explanation from Robertson himself, not from Jones. The part which is worth dwelling on is what relates to Jones. If Dodson wrote a fair common English, the whole falls to the ground. His printed writings show nothing either odd or confused: but he may have got somebody to write them *all*. He could hardly have kept a composer for his own private letters; and I subjoin one to Robertson, which came into the hands of Dr. Hutton, from whom it passed to Dr. Olinthus Gregory, at whose sale I bought it. The reader is to see whether the meaning comes at once or whether he must read a sentence twice before he understands it.

Sir. Being the other day turning over Mr. Simpson's new book, I took it in my head to try how much better his new approximations to the roots of equations were than those we commonly use, and find that his examples are packed, being such as our common operations will give to six or seven places the first substitution; which, with all his apparatus, he seldom exceeds above a figure or two. I determined therefore to reject his pretended improvement and stick to the old way in the work I am putting together for Mr. Knapton [what this was I do not know] and set about composing that part of it.

I believe you have found as well as I that these approximations are difficult to be worded so as that a person who cannot read algebra should readily understand and retain them [Dodson was very fond of expressing algebra in words, and did it with unusual precision and clearness]; but it has happened that in this revision of the subject I have, by a little cooking of the old equation, happened upon the following approximation to the root of any surd, which I give you in words that you may see how easy it will be to remember it.

The number whose root is required I call the surd power. And the nearest similar real power, whether greater or less, I call the rational power.

Multiply the rational power by the *index more one*, and to the result add the product of the surd power by the *index less one*; reserving the sum.

Also multiply the rational power by the *index less one*, and to the result add the product of the surd power by the *index more one*; reserving also this sum.

Then as the first mentioned sum is to the second, so is the root of the rational power to the root of the surd power.

I have sent you this in hopes it may come in time enough for the cube root in the arithmetical part of your navigation. And for that root it runs easier, thus.

To twice the rational cube add the surd cube, and to twice the surd cube, add the rational cube. Then as the first sum is to the second, so is the root of the rational cube to the root of the surd cube. (Please turn over.)

The investigation, being rather too long for a letter, I reserve till I see you unless you desire it further, when I will transcribe and sent it.

We have had a fortnight of very indifferent weather, but make shift to keep jogging on, and I am in great hopes the field-work may be finished before I am obliged to come to town: my next shall enclose the draft, which should have come now, but Sir Tho. is from home. I am, Sir, your obliged humble servant, J. DODSON.

*Sept. 17, 1752, by Act of Parl<sup>t</sup> style.*

[This was the fourth day of the new style.]

And now for a letter from William Jones, which I happen to possess; the man of influence and official station, who used small mathematicians like dogs; and who was the corrector of Dodson's style. So far as one letter can go, it clears him of both imputations. It is to Hodgson, Dodson's predecessor but one, and is addressed on the outside "To Mr. James Hodgson, at Christ's Hospital, London, these presents." Hodgson's life was a counterpart of Dodson's: he was a private teacher and writer who ended in the mastership of the Royal Mathematical School.

Honoured and beloved Sir. The Wednesday I came away I delivered the papers to your servant. It's my design to send them up in a little time, the calculations of problem (4) at large, so that everything may be evident to you as you proceed, without any trouble. I have altered the method from case (1) of Astronomic Problem (6) to case the (2) and hope to render it of more easy, universal and exact use. I will send one for the papers, and fairly insert problem (4) in writing among the others, and send them up to you without fail as soon as possible. I remain, most worthy Sir, your most obliged humble servant, W. JONES.

*Wantage, June 17, 1731.*

It is somewhat remarkable that so decided an instance of confused style should turn up, to set against the clearness of Dodson's writing. The reader asks how Jones could send up from Wantage the papers which he had left with Robertson's servant some Wednesday before: and he finds at last that "them" refers to papers spoken of afterwards.

Dodson's criticism upon Simpson's method refers only to its

utility as a means of approximation, and is just: but neither Dodson nor Simpson himself saw its beauty as a theorem. As it is never mentioned in modern works I give it, without demonstration, in modern symbols.

To approximate to the small root of an equation, proceed as follows. Let the equation be  $c_0 + c_1x + c_2x^2 + \dots = 0$ , and determine\*  $D_1, D_2$ , &c.,  $N_1, N_2$ , &c., from

$$\begin{aligned} c_0D_1 + c_1 &= 0, & c_0D_2 + c_1D_1 + c_2 &= 0, & c_0D_3 + c_1D_2 + c_2D_1 + c_3 &= 0, \\ c_0N_1 + c_2 &= 0, & c_0N_2 + c_1N_1 + c_3 &= 0, & c_0N_3 + c_1N_2 + c_2N_1 + c_4 &= 0, \end{aligned}$$

and so on. Then

$$- \frac{c_0D_n}{c_1D_n - c_0N_n}$$

is the nearer to the root of the equation, the greater  $n$  is taken.

Dodson's share in the projection of the Equitable is first mentioned in general publication by Nichols (*Anecdotes*, vol. v., p. 400). But the following extracts, with which I was favoured by Mr. Arthur Morgan, contain the whole account.

In 1769 was circulated by the Directors a pamphlet entitled "A state of the Society for Equitable Assurances on Lives and Survivorships, and a state of facts from the year 1756 to the present time. Laid before the General Court the 28th of July, 1769, by the Court of Directors."

The following is an extract.

1756. In this year Mr. James Dodson, having been refused admission to the Amicable Society on account of his age, determined to form a new Society upon a plan of assurance on more equitable terms than those of the Amicable, which takes the same premium for all ages. Having communicated this plan to several persons, they proposed to join him therein, if the intended Society could be established by Charter. The number of persons which engaged in this design were at first 55, and before they proceeded towards obtaining a charter, they set about providing a fund, and previous even to this consideration they held consultations about the plan of reimbursement and recompence that should be made to Mr. Dodson and themselves. Accordingly it was determined that 15*s.* should be paid by every person making assurance with the said Society; 5*s.* whereof should be paid to the said James Dodson for his life for his plans and trouble in planning the said Society, and making the necessary calculations; and the other 10*s.* were to go among the other persons [Raw beginners! primitive Christians! In our day this would be called *omission*, not *commission*: I never blushed for an ancestor until now.] The

\* I use D and N because they enter in the demonstration as denominator and numerator. I suppose the D and N of our commutation tables were chosen by Griffith Davies from the part they play in  $\frac{N}{D}$  the first of the results wanted, and the suggesting formula. But this never struck me until now; and perhaps never struck some of my readers.

application for a charter was conducted by Mr. Mores, and after three hearings before the Attorney and Solicitor General, to whom the petitioners were referred by his Majesty, a report was given against the petitioners. The petition having been presented at the Secretary of State's Office on the 16th or 17th of April, 1757, and referred to the Attorney and Solicitor General, who did not make their final report until the 28th of July, 1761. In the mean time, that is to say on the 23rd of November, 1757, Mr. Dodson died. The hopes of a Charter being at an end, the generality of the original subscribers dropt the scheme, in the prosecution of which £600 had already been expended. [In the deed of settlement provision is made for the repayment of this money]. Mr. Edw. Rowe Mores, however, and 16 more of the 55, resolved to persevere in establishing such a Society by deed, if it could not be done by Charter; and the present deed of settlement, of the 7th of September, 1762, was executed by every one of these 16 original Charter-fund proprietors. No table of calculations was procured till the 24th of January, 1764, and the Directors relying upon Mr. Mores for fixing every premium in the intermediate time. But at length such a table of lives was procured from the Executors of Mr. Dodson, and a resolution was put on the minutes for giving £300 to the children of Mr. Dodson as a recompence for the same.

In a statement published and signed by Rich. Glyn, J. Sylvester, Wm. Selater, Edw. R. Mores, and Josiah Wallis, in reference to the Charter-fund, is found the following.

The subscribers admit that in the year 1756, Mr. Dodson, not being able to obtain admission into the Amicable Society on account of his age, conceived a design of forming a Society upon the principle laid down by the late Dr. Halley, in his observations on the Breslau bills of mortality, viz. that the price of insurance on lives ought to be regulated by the age of the person upon whose life the insurance should be made. And that he, Dodson, caused to be inserted in the public papers an advertisement bearing date the 28th of February, 1756, giving notice of a meeting intended to be holden on the 2nd of March then next following, and desiring at that meeting the company of such gentlemen as might be disposed to engage in such an undertaking. That they did accordingly meet upon the day appointed, and continued to meet weekly till the number amounted to about one hundred.

Mr. William Morgan, in his 'account of the Rise and Progress of the Equitable Society,' gives the account of the finish of Dodson's connexion with the Society, as follows.

Mr. Mosdell, who was stated to have been only an accountant, was appointed by the deed of settlement to be the first actuary, and on his death in December, 1764, [probably after six months trial, for the Equitable books show that the appointment is dated July 5, 1765,] Mr. [James] Dodson succeeded, who was the son of the excellent mathematician who computed the Society's tables, but without the mathematical learning of his father [he was then just twenty-one years old, and the appointment must have been an acknowledgment of the father's services]. Upon obtaining a place in the Custom House more suitable to his abilities, Mr. Dodson resigned in April, 1767, when Mr. John Edwards was chosen . . .

I will now give a few words to each of Dodson's works. I find them all mentioned in Watt's *Bibliotheca*, that is, all which I have ever seen; and I never heard of any others. And the heading is one of those short accounts which often occur in Watt, which could not be mended in the same number of words. "Dodson, James, F.R.S., an ingenious and very industrious mathematician in London."

The Anti-logarithmic Canon. Being a Table of Numbers, Consisting of Eleven Places of Figures corresponding to all Logarithms under 100000. Whereby the Logarithm for any Number, or the Number for any Logarithm, each under Twelve Places of Figures, are readily found. With Precepts and Examples, showing some of the Uses of Logarithms, in facilitating the most difficult Operations in common Arithmetic, Cases of Interest, Annuities, Mensuration, &c. To which is prefix'd, An Introduction, Containing a short Account of Logarithms, and of the most considerable Improvements made, since their Invention, in the Manner of constructing them. By James Dodson. London: Printed for James Dodson, at the *Hand and Pen* in *Warwick-Lane*; and John Wilcox, at *Virgil's Head*, opposite the *New Church* in the *Strand*. 1742.

I should like to have a list of the authors who have shown their sense in the first words of the title of their first works: Dodson would find a place. The words "*desiderandus videtur Canon Anti-Logarithmicus*" were used by Wallis as far back as 1693. Young men very often think it is *original-like*, you know, to find their own phrases where good ones have been found by their foregoers. There is an appendix of five pages, not mentioned in the title. "*Of Decimal Notation, and its Use in solving Questions, which consist of Fractional Numbers by Logarithms.*" The work is dedicated to Lord Stanhope (Chesterfield). It was reviewed in the *Works of the Learned* for September, 1742, in so terse and accurate a way, and so free from eulogium, that I have no doubt the author wrote the article.

There is a tangled story about the antilogarithmic Canon finished in manuscript by Warner and Pell. The utility of common slanderers lies not in what they produce, but in what they omit: as to all of which there is a strong presumption that no means of constructing a story existed. If there had been a rumour, even a surmise, afloat that Dodson had seen this manuscript, Burrow would have got hold of it, and would have left it that Dodson had cribbed the work out of William Jones's library, and had published it as his own. And nothing but a very cautious comparison will show that he had not the *opportunity* so to do. For Collins's papers, in the bulk, came into the hands of William



Jones, and were freely open to the crowd who had the liberty of his study: and Collins was certainly at one time the custodier of Warner's manuscript. No doubt a Canon with eleven hundred thousand computed figures, "elegant, in a large folio," would have been well known among the many mathematicians who haunted Jones's house and who knew what Wallis had written about it; and its surreptitious publication would have required the complicity of Jones and Robertson, at least, and the character of the transaction would have been known to many. But this is not all: it appears that Warner's manuscript, deposited with Collins to be restored on demand, actually did pass out of Collins's hands into those of Dr. Busby. It has never since been mentioned as seen. The authorities for the following collection of facts, Wallis, Pell, Thorndyke, and Collins are to be found in the *Latin Algebra* of Wallis (*Opera*, vol. ii., *Alg.* cap. xii.); the *Macclesfield Correspondence* (vol. ii., p. 197, 215, 219); and Halliwell's *Letters on Scientific Subjects* (Hist. Soc. Sci., pp. 80, 94, 95).

Dr. Pell informed Wallis that Warner, assisted by himself, had finished a *canon* not long after 1631: "about fifty years ago," says Wallis, which makes his writing to be near 1680, and very likely later. Wallis saw this canon, about 30 years before writing, say near 1650. In 1644, Pell, writing to Sir Chas. Cavendish, is in trouble about Warner's papers, the custodiers of which had become bankrupt, and he feared the papers had been or would be destroyed. We can only hope that poor Pell met all his troubles with as good heart as this one.

In the mean time I am not a little afraid that all Mr. Warner's papers, and no small share of my labours therein, are seized upon, and most unmathematically divided between the sequestrators and creditors, who (being not able to ballance the account where there appeare so many numbers, and much troubled at the sight of so many crosses and circles in the superstitious Algebra and that blacke arte of Geometry) will, no doubt, determine once in their lives to become figure casters, and so vote them all to be throwen into the fire, if some good body does not reprieve them for pye-bottoms, for which purposes you know analogicall numbers are incomparably apt, if they be accurately calculated.

The papers were found, and in 1652, we find them in the possession of Dr. Thorndyke, prebendary of Westminster, who as the trustee and holder of Warner's papers, among which the full canon and an abridgment are particularly specified, writes to Pell to urge publication of the whole, and seems to admit that Pell has the copyright: a note by Pell, endorsed on the letter, states that publication is abandoned on account of incompleteness, not of the

*Canon*, but of "the papers." No more appears until December, 1667, when we find the receipt given by Collins to Thorndyke, acknowledging the receipt of the *Canon* and other papers, to be restored on demand. In Sept., 1675, Collins writes to Tschirnhaus as follows:—

Between the years 1630 and 1640 Dr. Pell and one Mr. Warner, deceased, mentioned in Mersennus, agreed to make a table of antilogarithms, which were to be called Antilogarithmi Pellio-Warneriani; and accordingly such a table was computed, and left in the hands of Dr. Thorndyke, deceased, and cost Mr. Warner above 400 crowns the doing: as to the table itself it is a table of 99998 mean proportionals between an unit and 100,000, each to eleven places of figures, elegant, in a large folio....

Thorndyke was dead, and Collins does not say he had the table in his possession when he wrote: probably Thorndyke's executors found Collins's receipt and reclaimed the papers. Again, Collins, four years before, writing to James Gregory, March, 1671, gives the same account, as follows:—

One Mr. Warner, deceased, whose *Optics* you find mentioned in Mersennus, did, about 32 years since, spend above an hundred pounds for aid, and took great pains himself, with some assistance from Dr. Pell, to calculate a table to twelve places of figures of 100,000 continual proportionals, to wit, to find 99999 mean proportionals between an unit and 100,000. Such a large table, elegantly writ, remains in the hands of Dr. Thorndyke, a prebendary of Westminster; the construction and uses of it, with the tactions of circles rendered analytical, were lent to one Gibson, deceased, in anno 1650, author of a book entitled *Syntaxis Math.*, after whose death all his papers were consumed to light tobacco." (*Maccl. Corr.* ii. 219.)

And again (p. 197, in a letter of which the date must be altered) "the tables I mentioned in Dr. Thorndyke's hands." So that the manuscript had gone back from Collins in 1671. It is passing strange that Collins, who was very well informed, and whose immense correspondence got him the name of the Attorney-General of the mathematics, should have been quite ignorant of Warner, Harriot's executor and the publisher of his very celebrated algebra, except as a person mentioned by Mersenne who, on like grounds, should have been the *Procureur-Général*.

Wallis, when he wrote his note, not far from 1680, to which he put a last paragraph after 1685, says that Pell—who must have known all about it—told him the papers were in the hands of Dr. Busby, of Westminster school, a very likely man to be the executor of the prebendary, and a very unlikely man to come by mathematical papers in any other way. When Pell made this communication to Wallis, he was meditating immediate publication, and his business was to ask Wallis to see the printing finished, in

case of his own death during the proceeding; to this Wallis assented. In 1755, Dr. Birch procured for the Royal Society some of Pell and Warner's papers from the trustees of Dr. Busby. The antilogarithmic canon—I mean the manuscript, to avoid all mistake; Dr. Busby himself was a canon, and probably an antilogarithmic one—might, or might not, have been among them. Rigaud inadvertently writes that Birch procured “four large boxes” of these papers for the Society: but Birch only says that the Pell and Warner papers were mixed with Busby's papers in four large boxes: if these boxes exist, the canon may be in them still. But it strikes me as most likely that Pell, a man of energy and impulse, after arranging with Wallis, obtained possession of the manuscript with intent to publish immediately, and that it was mislaid at his death. He was a “shiftless man,” and shirtless too, sometimes: he often wanted pen and paper; he was in the King's Bench not long after his conversation with Wallis; and he died in poverty, and was buried at the cost of Dr. Busby.

It is clear that Dodson had no opportunity of seeing Warner's manuscript in the possession of William Jones or any one else that we know of. But it would be strange if there were none to suspect that he got at it amosgepotically (that is, somehow or other) and made fraudulent use of it. *A priori* wisdom will find difficulties in any other hypothesis. Why should Dodson, of all persons, meditate so large an undertaking, and why an antilogarithmic canon rather than anything else? He knew Wallis's account, which he quotes; and he might have seen Collins's letters in Jones's collection. What more easy than to suppose that he made a hunt for the manuscript? Suppose him to have once been a Westminster boy—he must have gone to school somewhere—and to have made use of his knowledge to gain access to Busby's boxes; what more is wanting? But though amusing myself with the love of evil which cannot help inventing all that is wanting to prove it, I am quite aware that it is open to anyone who can to trace the manuscript, and to examine the circumstances, in order to see whether—all apparent impossibility notwithstanding—Dodson found it and used it. It is quite certain that the fact of such a manuscript having existed must have been known in William Jones's circle: Wallis in print and Collins in the letters in Jones's library must have been referred to when Dodson published his Canon: and the acquisition of Busby's papers, in 1755, is presumption that the possibility of obtaining the manuscript was recognized; and not quite despaired of.

The only thing to be explained is the accordance of Warner and Dodson in extent of plan: five figures of argument and eleven of tabular result. The explanation is that both Warner and Dodson naturally aimed at making their tables coextensive with the great tables of Briggs and Vlacq. These had *eleven* figures; we now say ten: but the characteristic formerly counted as a place of the logarithm. Both Warner and Dodson judged correctly that their table would lose much of its working value for high purposes if, going above seven figures, it were anything less than the numerical counterpart of the great tables, which must be used with it.

Dodson very fairly quoted all he knew about Warner; that is, he gave the passage from Wallis's *Algebra* of 1693, in English. But, apparently dissatisfied with the translation which had appeared in two editions of Sherwin's logarithms, he translated anew, referring to Sherwin.

I will here mention that the correction of misprints found in the copies of the *Canon* are in most cases in Dodson's own handwriting. He followed this practice in more works than one.

1747. Octavo (half sheets). *The Calculator: being, correct and necessary Tables for Computation. Adapted to Science, Business, and Pleasure.* By James Dodson, *Accomptant, and Teacher of the Mathematics.* London: Printed for John Wilcox, at *Virgil's Head*, opposite the *New Church* in the *Strand*; and James Dodson, next Door to the *Blue Legg*, near *Bell-Dock, Wapping.* M.DCC.XLVII.

This work is dedicated to William Jones. Some copies have another title page, also of 1747, in which Wilcox alone is mentioned in the imprint. This means that Wilcox took the risk off Dodson's hands within the year; and thenceforward we no more find him publishing on his own account.

With the exception of heavy calculators, to whom the *Canon* is occasionally useful—Benjamin Gompertz, for instance, who told me forty years ago he was always wanting it—this table is worth three of the *Canon* to anybody. Whoever can catch a copy should keep it. The table of binomial coefficients, up to the 34th power, is very useful. So is the table of specific gravities. The medley of coins, measures, regular solids and polygons, roots, logarithms, common, hyperbolic, logistic, trigonometrical, &c., interest, annuities, &c. &c., though not extensive, are great friends at a pinch. For a single book to travel with, and a good chance for anything that can be wanted, I know only Mr. Willich's table which can compare with it. But Dodson's two or three words to each head in the preliminary index enable the user to find his table in a

moment. The only additional friend mentioned is John Ellicot, F.R.S., the (in that day) celebrated watchmaker.

1747-48, 1753, 1755, 12mo. The three volumes of the *Mathematical Repository*, by James Dodson, Accountant and Teacher of the Mathematics. The full titles will recal the contents: they describe the volumes as

(i.) Containing analytical Solutions of near five hundred questions, mostly selected from scarce and valuable authors. Designed as examples to Maclaurin's and other elementary books of algebra; and to conduct beginners to the more difficult properties of numbers.

(ii.) Containing algebraical solutions of a great number of problems, in several branches of the mathematics. I. Indetermined questions, solved generally, by an elegant method communicated by Mr. De Moivre. II. Many curious questions relating to chances and lotteries. III. A great number of questions concerning annuities for lives, and their reversions; wherein that doctrine is illustrated in a multitude of interesting cases, with numeral examples, and rules in words at length, for those who are unacquainted with the elements of these sciences, &c.

(iii.) Containing analytical solutions of a great number of the most difficult problems, relating to annuities, reversions, survivorships, insurances, and leases dependent on lives; in which it has been endeavoured to exhaust the subject.

All is 'printed for John Nourse, at the Lamb, opposite Katherine Street in the Strand.' The dedications are to De Moivre, David Papillon, F.R.S., and Lord Macclesfield and the Council of the Royal Society. There was a second edition of the first volume in 1775; I am not aware of any other editions of the remaining volumes. I should think there were none, for the remaining stock of the work was locked up by some of the incidents of trade, and was let out about 35 years ago, when the market was suddenly supplied with uncut copies.

1750, 4to. *The Accountant, or the method of book-keeping, deduced from clear principles, and illustrated by a variety of examples.* By James Dodson, Teacher of the Mathematics. London printed for J. Nourse at the Lamb opposite Katherine-Street in the Strand.

This book is dedicated to Lord Macclesfield, whose accounts Dodson seems to have been employed in, and who, it is hinted, desired that double entry should be applied to the business of an estate and of a farm. The work also applies it to retail trade, a thing till then unexemplified: and the shoemaker's trade is chosen on account of the variety of his transactions. This book is excessively scarce: the copy in the Museum and my own being the only ones I ever heard of.

1751. 8vo. In this year Dodson published an enlarged edition of Wingate's *Arithmetic*. The preface is dated April 4, 1751.

It was reprinted several times. I have only seen the edition of 1760. Wingate is the best of the old writers, greatly superior to Cocker (or rather Hawkins): and Dodson's are the best editions of Wingate, according to Watt—and myself. Wingate and Cocker were the two household-gods of arithmetic. In 1750, Arthur Murphy introduced their names upon the stage in 'the Apprentice,' Wingate as an old merchant who is constantly recommending Cocker: and I believe that this is the way in which Cocker became a bye-word; I can find nothing earlier.

4to. (pp. 18). An account of the Methods used to describe lines, on Dr. Halley's Chart of the Terraqueous Globe; showing the Variation of the Magnetic Needle about the Year 1756, in all the known Seas; their Application and Use in correcting the Longitude at Sea; with some Occasional Observations relating thereto. By William Mountaine and James Dodson, Fellows of the Royal Society. London: Printed for W. and J. Mount, T. Page and Son, on Tower Hill. 1758.

Of Mountaine I only know that he was one of the founders of the Equitable, and that he was Dodson's executor. Watt calls this tract a folio, and gives it a first edition in 1718. The truth, as appears by the tract itself, is that in 1744 the two collected observations from the Admiralty, the India and African companies, and private communications. On these data they published a chart in 1745, which I have never seen. By this chart Dodson must have been known as having paid attention to matters connected with navigation, a circumstance which may have facilitated his appointment to the R. M. School.

To the preceding list must be added three papers in the *Philosophical Transactions*; 1752, p. 333, on the improvement of the bills of mortality; 1754, p. 487, on annuities and survivorships; 1753, p. 273, on logarithmic series. The second and third papers are written to show how to dispense with the use of fluxions, which all the mathematicians who could were very apt to intrude into every part of algebra above the merest elements. This practice did much harm: the packing up of all the difficulties of series into the abbreviations of the differential calculus was a fearful drawback on the rigour of the science. It is only in our own day that mathematicians have become alive to the danger of all sorts and conditions of interminable series. Here is an instance for the reader of the mathematical part of this *Journal*. Take the series

$$\frac{4-3x}{1.2}x + \frac{16-15x}{3.4}x^3 + \frac{36-35x}{5.6}x^5 + \dots$$

This is certainly convergent when  $x$  is  $<$  or  $=1$ . When  $x=1$ , it seems to be  $\frac{1}{1.2} + \frac{1}{3.4} + \frac{1}{5.6} + \dots$  or  $1 - \frac{1}{2} + \frac{1}{3} - \frac{1}{4} + \frac{1}{5} - \frac{1}{6} + \dots$ , or hyp. log 2. But it is not: what is it, then?

The algebra of annuities, &c., was put into working form by De Moivre, Simpson, and Dodson, who gained the necessary restraint upon themselves by having been occupied in the actual practice of the subject. It is almost a rule that a writer on any mixed mathematical subject who has not been actually engaged in *mixture* overdoes the mathematical part: I do not mean that he introduces mathematics where it ought not to be—this he may or may not do—but that he makes too much of mathematics where some ought to be. De Waring, one of the most useful algebraical discoverers of the century, made a great failure in an attempt to write on the subject: and as the history of his tract is peculiarly matter for this *Journal*, I will end with it.

The book was called ‘On the principles of translating algebraic quantities into probable relations and annuities, &c. By E. Waring,’ Cambridge, 1792, 8vo. (pp. 59). It would have sold well if the implied title-promise had been kept: it is not every one who can translate algebraic quantities into an annuity, or into a probable relation with the chance of a reversionary legacy. As it was, no book ever fell more dead from the press: it is not mentioned by any of Waring’s biographers before 1815. Some notice of it was taken in the first edition of Hutton’s *Mathematical Dictionary*, vol. ii. p. 276, which induced Mr. Baily to write to Hutton for information. Hutton answered that he had never seen nor heard of the tract; that the account in which it appeared was furnished by Waring himself, whom he took to be good authority for a work of his own: that it certainly was not one of the pamphlets which passed between Waring and Powell during the contest for the professorship; but that he had found a “referment” to it in Wood’s Algebra. Baily accordingly wrote to Dr. Wood, who in answer gave the title, and offered to lend his own copy (Sept. 5, 1808). The offer was accepted; for on the 15th Baily wrote to Hutton a short account of the work, which he described in stronger terms than he afterwards used in his book on assurances (Pref. p. xx.), and in which I quite agree with him. “Certainly he has thrown no new light on the subject. His problems (if a string of detached observations are worthy of that name) are quite

elementary, and his loose and illogical [he meant *immethodical*\*] method of treating them adds neither grace nor dignity to the subject. The very title of the book betrays the inaccuracy of his style." Baily afterwards picked up a copy for himself. When I came to look after this book, about 1835, I could find no mention of it: and I asked Mr. Baily to lend it to me. He could not find it; and I ventured to express a suspicion that he had mistaken the author's name. Whereupon he produced† what he knew where to find at once, the bookseller's receipt, which stated name and title. It turned up when his books were arranged for sale, and I bought it. Some time afterwards I found that the library of Queen's College, Cambridge (which was not Waring's College), contained some half dozen copies. A few of these were, upon representation of the state of the case, presented to other libraries, I forget which: probably the Royal Society or the British Museum will now possess the book.

I have never had so strongly impressed upon me the littleness of the period preceding the accession of Geo. III. We do not make much boast of its collective literature, and yet it was the day of Mansfield, Fielding, Sam. Johnson, David Hume, Sterne, Gray, Garrick, Blair, Hor. Walpole, Smollett, Robertson, Adam Smith, Blackstone, Joshua Reynolds. In applied science there was no great strength: but in pure mathematics we have little more than the remnants of a stronger period: some good names, but far too few to count as a school, belong especially to the time. Its historical masterpiece is the *Biogr. Philosoph.* of Benjamin Martin

\* In reply to a suggestion whether *unmethodical* would not be the preferable word, Mr. De Morgan writes:—"I made the word *immethodical*, upon the old analogy. *Un* is Saxon; and properly belongs to Saxon words, as *unaware*, *unbeaten*. *In* and *Im* are for Latin; though certainly the Saxon has intruded, as in *ungovernable*, *unsophisticated*, *uncommon*, &c. But the great bulk of our Latin words still keep *im* or *in*, according to the consonant which follows, as *imperceptible*, *immense*, *innocent*, and a crowd of others. On looking for *immethodical* in a little sixpenny Johnson of the stalls,—there it is. I generally consider the foreign dictionaries as good authorities as to English words: and in the French, German, and Italian which I keep at hand, I find the word in all. I find capricious cases; as *interminable* and *unterminated*, *indeterminate* and *undetermined* (of which the mathematicians have availed themselves). Also *insatiate* and *unsatiated*. The rule seems to be that when the Saxon *ed* is at the end, the Saxon *un* shall be at the beginning; and Latin, Latin. This may be called the *sandwich* rule, if it be a rule. The end of it is that any one may do as he pleases, which is the glory of English."—Ed. J. I. A.

† Francis Baily was a paragon of method: he practised and enforced. I found him one day in the act of finishing a note, which he showed me; it was before the time of *prepaid* letters. One of those tradesmen who, when a customer is as good as the bank, persist in making a banker of him during convenience, would not send in his bill. The note ran as follows:—" (No. 1). Sir,—I beg you will oblige me by sending in your account forthwith. Yours, F. BAILY. P.S. This notice will be repeated once a week until it is complied with." No. 2 was not wanted: the tradesman declined to grant His Majesty an annuity of 8s. 8d., payable weekly.



(1761), a work of unmatched inutility. And yet good biography had commenced in force with the *Biogr. Brit.* in 1747. The total absence of historical effort encouraged the learned vicar of Twickenham, George Costard, to give to his work on the globes, (1767), full of every kind of miscellaneous historical statement, the title 'History of Astronomy.' All my reading has led me to suspect that the doubts and dangers of the disputed right to the Crown, which lasted from the rising of 1715 to that of 1745, produced a paralysing effect upon the intellectual energies of the country.

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*On the Application of Bonuses to limit either the term of an Assurance or the number of payments to be made under it: being Excerpts from a paper read before the Actuarial Society of Edinburgh, on 5th December, 1867. By JAMES R. MACFADYEN, of the City of Glasgow Life Assurance Company.*

THE application of bonus to the hastening of the time fixed by the original contract for the payment of a life assurance policy, and the using of it to extinguish the premiums payable during the latter years of life, are systems, which, partly from their growing favor with the public, and consequent adoption by many offices, and still more from the fact, that the subject is by no means exhausted, notwithstanding various able articles that have appeared in this *Journal*, seem to me to render apology unnecessary for again treating of it.

The papers to which I allude as having already taken up the matter, are two articles by Mr. Sprague in the sixth volume, embracing both branches of the subject, and a more recent letter by Mr. Marr, (vol. xiii. p. 246) referring to the first of these two systems alone.

Though, as we shall hereafter see, these systems of applying bonus are very closely allied in character, and they have thus been coupled in this paper, it will be more convenient in the first place to confine ourselves to that in which the bonus is applied to limit the *term* of insurance only.

The problem usually arising in this case is to find the term of the Endowment Assurance into which a given cash bonus will convert an ordinary assurance. Mr. Sprague solves this problem by making an equation at the age the change is effected between <sup>1</sup>b, the cash bonus then allocated to the policyholder, which is the